

WHAT IS CLAIMED IS:

1. A system for searching web pages comprising:
a database for storing connectivity information about the web pages; and
a page-grading engine associated with an approximation matrix Q' , where Q' approximates an ideal matrix Q with respect to the connectivity information;
wherein the page-grading engine receives as input a personalization description v describing a set of preferences among the web pages, and grades search results with respect to Q' and v .
2. The system of claim 1 wherein approximation matrix Q' is a rank- k matrix whose representation comprises a singular value decomposition comprising matrices V_k , S and U_k^T for a parameter k .
3. The system of claim 2 wherein v is a vector and Q' times v is an optimal approximation to Q times v over all rank- k matrices.
4. A method of grading objects from an interconnected collection of weighted objects, the weights of the objects described by a description v , and the interconnection of the objects described by a description P , the method comprising:
applying a grading function Q' to the description v for the objects to determine a set of grades for the objects; and
assigning at least one object the corresponding determined grade for that object;
wherein the grading function Q' approximates an ideal grading function Q , where applying ideal grading function Q to the description v produces ideal grades with respect to description P for every object in the interconnected collection of weighted objects.
5. The method of claim 4 wherein P , Q , and Q' are matrices, v is a vector, and the approximation is a low-rank optimal approximation.

6. The method of claim 5 wherein entry $P[i,j]$ in matrix P represents the probability of reaching one object i from another object j in one step of a random walk among the weighted objects.

7. The method of claim 6 wherein at each step of the random walk there is a fixed probability c that the walk will reset, and that the random walk then continues from object a with probability $v[a]$.

8. The method of claim 7 wherein the ideal grade of an object b is the probability of arriving at object b at a step of the random walk.

9. The method of claim 5 wherein the objects are web pages.

10. A method of grading objects from an interconnected collection of weighted objects by approximating a matrix Q with respect to a parameter k , comprising:

computing a matrix U_k ;

computing a matrix V_k ;

computing a diagonal matrix S ;

defining the approximation to Q as the matrix product $V_k S U_k^T$; and

determining a grade for at least one of the objects using the approximation to Q ; wherein the weights of the objects are described by a vector v , the interconnection of the objects is described by a matrix P , and the ideal grade of object i with respect to matrix P equals $Q[i]$ times v where $Q[i]$ is the i th row of an ideal matrix Q .

11. The method of claim 10 further comprising:

choosing a sufficiently large parameter d ; and

computing an intermediate matrix M with respect to P ;

wherein matrix U_k comprises the k principal eigenvectors of $dI - MM^T$ and matrix V_k comprises the k principal eigenvectors of $dI - M^T M$, and wherein matrix $S = (dI - D)^{-1/2}$, where D is the diagonal matrix comprising the k eigenvalues corresponding to the k principal eigenvectors of $dI - MM^T$.

12. The method of claim 11 wherein computing an intermediate matrix M with respect to P is further with respect to a constant c .
13. A system for grading objects from an interconnected collection of weighted objects comprising:
 - a description v of the weights of the objects;
 - a description P of the interconnection of the objects; and
 - an object-grading engine for approximating an ideal grading function Q with an approximate function Q' , where applying ideal grading function Q to the description v produces ideal grades with respect to description P for every object in the interconnected collection of weighted objects, and for assigning at least one object the grade produced for that object by an application of Q' to v .
14. The system of claim 13 further comprising a search engine in connection with the object-grading engine, wherein the object-grading engine grades objects passed from the search engine.
15. The system of claim 13 wherein the objects are web pages.
16. A computer-readable medium including computer-executable instructions facilitating the grading of web pages, the web pages interconnected corresponding to a matrix P , computer-executable instructions executing the steps of:
 - computing a representation of an approximation matrix Q' to an ideal matrix Q ; and
 - applying Q' to a personalization vector v to obtain grades of the web pages.
17. The computer-readable medium of claim 16 wherein Q' is a rank- k matrix whose representation comprises a singular value decomposition comprising matrices V_k , S and U_k^T for a parameter k .
18. The computer-readable medium of claim 17 wherein Q' times v is an optimal approximation to Q times v over all rank- k matrices.

19. The computer-readable medium of claim 17, the computer-executable instructions further executing the steps of:

applying the grading of web pages produced by Q' to the results of a search query; and outputting the results of the search query sorted according the grading.